

REMARKS/ARGUMENTS

Favorable reconsideration of this application, in light of the following discussion, is respectfully requested.

Claims 27-29, 31-45 and 53-65 are pending in the present application, Claims 58-64 having been withdrawn.

In the outstanding Office Action, Claims 27-29, 34-36, 41-43, 45, 53, 54, and 65 were rejected under 35 U.S.C. §103(a) as unpatentable over Neilson et al. (U.S. Patent No. 6,054,369, hereinafter Neilson) in view of Kakumu (U.S. Patent No. 5,654,241) and further in view of Yamamoto et al. (U.S. Patent No. 4,577,396, hereinafter Yamamoto); Claims 31-33 and 55-57 were rejected under 35 U.S.C. §103(a) as unpatentable over Neilson, Kakumu, and Yamamoto, and further in view of Kish, Jr. et al. (U.S. Patent No. 5,783,477, hereinafter Kish) and Abe et al. (U.S. Patent Publication No. 2002/0157790, hereinafter Abe); Claims 37, 38, and 44 were rejected under 35 U.S.C. §103(a) as unpatentable over Neilson, Kakumu, and Yamamoto, and further in view of Kub et al. (U.S. Patent No. 6,274,892, hereinafter Kub); and Claims 39 and 40 were rejected under 35 U.S.C. §103(a) as unpatentable over Neilson, Kakumu, and Yamamoto, and further in view Yu et al. (U.S. Patent No. 6,410,371, hereinafter Yu).

Applicants thank the Examiner for the courtesy of an interview extended to Applicants' representative on October 15, 2010. During the interview, differences between the present invention and the applied art, and the rejections noted in the outstanding Office Action were discussed. No agreement was reached pending the Examiner's further review when a response is filed. Arguments presented during the interview are reiterated below.

Applicants respectfully traverse the rejection of Claim 27. Claim 27 recites

implanting a metallic species in at least the first
wafer at a dose above 10^{16} species/cm²,

assembling the first wafer and the second wafer by
molecular bonding, and

after the molecular bonding, forming a metallic
ohmic contact including alloys formed between the
implanted metallic species and the semiconducting
materials of the first wafer and the second wafer, said
metallic ohmic contact being formed at an assembly
interface between the first wafer and the second wafer,

wherein the forming includes causing the implanted
metallic species to diffuse towards the interface between
the first wafer with the second wafer and beyond the
interface.

A proper combination of Neilson, Kakumu, and Yamamoto do not disclose every element of
Claim 27.

Neilson describes a semiconductor device in which the density of recombination
centers in a buffer layer adjacent to a blocking layer is significantly higher than that of the
blocking layer.¹ Recombination centers are locations of crystallographic strain.²

In Neilson, the doping concentration of 10^{14} cm^{-3} to 10^{19} cm^{-3} (col.4, l.51 of Neilson)
is far too low to make an ohmic contact (see Sze, page 187, first sentence of §3.6: “An ohmic
contact is defined as a metal-semiconductor contact that has a negligible junction resistance
relative to the total resistance of the semiconductor device” [emphasis added]). With the
concentrations given in Neilson, recombination centers are made, and any reaction between
the dopants and the substrate is too insignificant to form an ohmic contact.

Furthermore, a person of ordinary skill in the art would not modify the doping
concentration of Neilson to change the recombination centers into an ohmic contact. The
purpose of Neilson is to form recombination centers. Elimination of the recombination
centers would render Neilson unsatisfactory for its intended purpose of having recombination
centers (see, col. 2, line 40 to col. 3, line 27 of Neilson). According to MPEP §2143.01(V),

¹ Neilson, col. 2, lines 46-50.

² Neilson, col. 1, lines 26-29.

“If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification.” MPEP §2143.01(VI) also states, “If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious.” Changing the recombination centers to an ohmic contact would change the principle of operation of the device of Neilson since the recombination centers are an integral part of the semiconductor device of Neilson. The dopants would be concentrated in the ohmic contact because they have a low density in the material. No recombination centers would remain to provide the needed “layer adjacent a blocking layer of a semiconductor device is provided with a significantly higher density of recombination centers.”³

During the above-noted interview, the Examiner raised the possibility that the device in Neilson could have both recombination centers and an ohmic contact. Applicants respectfully submit that a person of ordinary skill in the art would not modify Neilson to have both recombination centers and an ohmic contact.

The purpose of Neilson is not only to have recombination centers. Rather, it is to particularly provide a device in which “a layer adjacent a blocking layer of a semiconductor device is provided with a significantly higher density of recombination centers.”⁴ To the extent it is even possible to modify Neilson so that some of the recombination centers are changed in to an ohmic contact, such a modification would frustrate the above-noted purpose of Neilson as it would alter the density of the recombination centers. In addition, col. 2, lines 51-57 of Neilson describes that recombination centers are substantially absent from the blocking layer. Thus, there is no reason to have recombination centers or an ohmic contact at the blocking layer.

³ Neilson, col. 1, lines 5-10. See also, Neilson, col. 2, lines 46-50.

⁴ Neilson, col. 1, lines 5-10. See also, Neilson, col. 2, lines 46-50.

Furthermore, Neilson describes transistors.⁵ It does not make sense to form an ohmic contact at the blocking layer and/or buffer layer of Neilson. Neilson concerns an interface between NP regions of a transistor (see Figs. 2C or 2D) or an interface with a blocking layer (see Figs. 2A or 1D). There is no reason to form an ohmic contact an interface with blocking layer 22. A person of ordinary skill in the art would not form an ohmic contact at an interface with a blocking layer which, roughly speaking, aims to block charge circulation. Col. 1, lines 59 to col. 2, line 19 of Neilson describes that the blocking layer has a high resistance, which is contradictory with having an ohmic contact. Ohmic contacts are not built where resistivity is to be kept high. The blocking layer is also for having a low leakage current (see, col. 1, line 61 of Neilson), which again is contradictory with having an ohmic contact at the interface with the blocking layer.

With respect to combining prior art elements, Applicants refer to the recently issued Examination Guidelines Update: Developments in the Obviousness Inquiry After KSR v. Teleflex (hereinafter Obviousness Guidelines).⁶ These guidelines state:

Even though the components are known, the combining step is technically feasible, and the result is predictable, the claimed invention may nevertheless be nonobvious when the combining step involves such additional effort that no one of ordinary skill would have undertaken it without a recognized reason to do so.⁷

The prior art does not recognize a problem with the device of Neilson. There is no recognized reason as to why a person of ordinary skill in the art would modify Neilson to include any extra steps or processing to form an ohmic contact as specified by Claim 1.

⁵ Neilson, col. 1, lines 11-22.

⁶ Federal Register, Vol. 75, No. 169, September 1, 2010.

⁷ Obviousness Guidelines, part A, combining prior art elements.

The references cited in the Office Action do not provide a "recognized reason" to the make the combination proposed by the Office Action. In other words, the record does not include evidence as to why a person of ordinary skill in the art would dispose an ohmic contact at the buffer layer/blocking layer interface of a transistor. There is no evidence that this would increase the speed of the transistor. Any such conclusion is mere speculation.

The PTO cannot base rejections on assumptions instead of established facts. See In re Warner, 379 F.2d 1011, 1017, 154 USPQ 173, 178 (CCPA 1967) as follows:

A rejection based on section 103 clearly must rest on a factual basis, and these facts must be interpreted without hindsight reconstruction of the invention from the prior art. In making this evaluation, all facts must be considered. The Patent Office has the initial duty of supplying the factual basis for its rejection. ***It may not, because it may doubt that the invention is patentable, resort to speculation, unfounded assumptions or hindsight reconstruction to supply deficiencies in its factual basis*** (emphasis added).

Further, one of ordinary skill in that art would not find it obvious to pick and choose the doping concentration disclosed by Kakumu in order to use it instead of the doping concentration of Neilson.⁸ There is no evidence that a person of ordinary skill in the art would have recognized any problem with the doping concentration of Neilson, nor would a person of ordinary skill in the art have any desire to reduce or eliminate the amount of recombination centers in the device of Neilson. Thus, there is no rationale for such a modification, absent improper hindsight based on the present claims.

While Kakumu may provide a reason for using its doping concentration to form titanium-silicide layers on portions where the source and drain are formed in a transistor,⁹ Kakumu fails to explain why a person of ordinary skill in the art would find it obvious to

⁸ See In re Ehrreich 590 F.2d 902, 200 USPQ 504 (CCPA, 1979) (stating that patentability must be addressed "in terms of what would have been obvious to one of ordinary skill in the art at the time the invention was made in view of the sum of all the relevant teachings in the art, not in view of first one and then another of the isolated teachings in the art," and that one "must consider the entirety of the disclosure made by the references, and avoid combining them indiscriminately.")

⁹ Kakumu, col. 3, lines 35-38.

incorporate such a feature to form an ohmic contact at an interface between a blocking layer and a buffer layer of a transistor such as the one disclosed in Neilson.

While Yamamoto may provide a reason for forming a silicide “into a desired *surface region* of a silicon substrate,”¹⁰ Yamamoto fails to explain why a person of ordinary skill in the art would find it obvious to incorporate such a feature to form an ohmic contact at an interface between a blocking layer and a buffer layer of a transistor such as the one disclosed in Neilson.

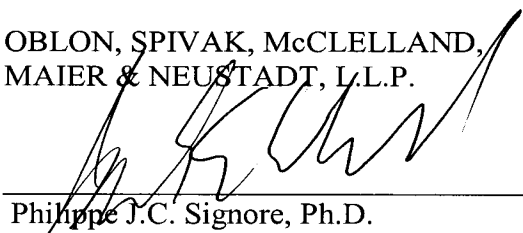
In view of the above-noted distinctions, Applicants respectfully submit that Claim 27 (and any claims dependent thereon) patentably distinguish over proper combination of Neilson, Kakumu, and Yamamoto.

Moreover, Kish, Kub, Yu, and Abe have been considered but do not cure the above-noted deficiencies in Neilson, Kakumu, and Yamamoto.

Consequently, in light of the above discussion and in view of the present amendment, the present application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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¹⁰ Yamamoto, col. 2, lines 25-30, emphasis added.